

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

**In re Patent Application of: Graves, Alan F.; Cunningham, Ian M.; Stark,  
Ryan; Felske, Kent E.; Hobbs, Chris; Watkins,  
John H.**

Serial No.	: 09/893,493	Group Art Unit	: 2633
Filed	: 06/29/2001	Examiner	: Bello, Augustin
For	: Communications Network For a Metropolitan Area		
Date	: August 16, 2007	Docket No.	: 08891912US1

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The Honorable Commissioner of Patents and Trademarks,  
MAIL STOP APPEAL BRIEF - PATENTS  
P.O. BOX 1450  
ALEXANDRIA, VA22313-1450

**SUBMISSION OF APPEAL BRIEF**

Sir:

This Appeal is from the decision of the Patent Examiner dated February 22, 2007 rejectin.g claims 1 - 26, which are reproduced as an Appendix to this Appeal Brief.

A Pre-Appeal Brief Request for Review was filed on June 11, 2007. A Notice of Panel Decision from the Pre-Appeal Brief Review was mailed on July 24, 2007.

Please charge the \$500.00 government fee to Deposit Account No. 50-1644.

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Respectfully Submitted,

/Xiang Lu/

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Xiang Lu

Registration No. 57,089

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**APPEAL BRIEF**

Applicants hereby appeal to the Board of Patent Appeals and Interferences from the last decision of the Examiner.

**(I) REAL PARTY IN INTEREST**

The entire interest in the present application, and the invention to which it is directed, is assigned to Nortel Network Limited, as recorded in the Patent and Trademark Office on Reel 011980, Frame 0338 on September 21, 2001.

**(II) RELATED APPEALS AND INTERFERENCES**

To the knowledge and belief of Appellants, the Assignee, and the undersigned, there are no other appeals or interferences before the Board of Appeals and Interferences that will directly affect or be affected by the Board's decision in the instant Appeal.

### (III) STATUS OF CLAIMS

Claims 1-26 are pending, all of which have been rejected. Thus, the rejections of claims 1-26 are appealed herein. A list of the claims on appeal is provided in the Appendix.

### (IV) STATUS OF AMENDMENTS

No amendments have been filed subsequent to the Rejection dated February 22, 2007.

### (V) SUMMARY OF CLAIMED SUBJECT MATTER

This invention relates to communication networks and more particularly to communications networks for metropolitan areas. See page 1, lines 20-21.

A communications network for a metropolitan area including three types of network nodes is described in Figure 3: an access multiplexer 12, a photonic edge switch 14, this switch is also referred to as a photonic switch, and the core node 16 which is part of a core network 22. The access multiplexers 12 provide multiplexing of data packets from end-users 4 over their local loops 5, which carry Ethernet fiber based multiplexed service connections or multi-service "VDSL-like" connections, and can act as the Ethernet mapping points for legacy services or connections, where these are capable of being carried in a high quality packet format, and maps all of these onto one or more Sparse-DWDM (S-DWDM) wavelengths, or a fiber. Sparse-DWDM is so-called because, although the carrier wavelengths are relatively coarsely spaced in the access plant, they are generated with an optical precision, especially with regards to optical carrier frequency, so they can map straight across into the tight optical frequency constraints of the DWDM network. These S-DWDM wavelengths, having a carrier frequency spacing of an exact multiple of the DWDM wavelength plan used in the core network are carried over fiber cable to the photonic switches 14.

The purpose of S-DWDM is to provide a way to taper the capacity of the fiber network between the core network and the access network, in a manner compatible with the use of photonic switching and limited or no wavelength conversion and no requirement for other E-O functions. The photonic switches 14 consolidate these wavelengths into DWDM wavelength spacing having a carrier frequency spacing of approximately 100 GHz for transmission to core nodes 16 or other photonic switches 14. Hence, one of the roles of the photonic edge switch is to act as an access wavelength consolidator or concentrator in the upstream direction, and as an expander in the downstream direction. The core node 16 includes a photonic switch (PSX) 19 and a service-aware terabit router core 20 for routing packets within the metropolitan area network or out to a long-haul network via the PSX 19. See page 20, line 23 to page 21, line 20, and Figure 3 of the present application.

The access multiplexers 12 transmit Ethernet data packets typically modulated on S-DWDM wavelengths to their respective photonic switches 14 over the corresponding fiber-optic cables 13. See page 24, lines 24-26, and Figure 3 of the present application.

The photonic switches 14a and 14b are connected to the core node 16 by fiber-optic cables 15a and 15b. See page 25, lines 17-18, and Figure 3 of the present application.

The network of Figure 3 embodies a novel approach that trades reduced bandwidth efficiency for increased functional simplification at the network level, where the number of operations performed on a packet stream transiting that network is markedly reduced, especially at the per-packet level, with much of the functionality being at the per-optical carrier level of granularity, rather than individual packet manipulation or other sub-optical carrier (sub-lambda) level, through the use of photonic (all optical) switches. See page 22, lines 1-8 and 31.

A method of operating a metropolitan photonic network is also described in the

present application.

In Figure 14, an access multiplexer 12 provides a dense wavelength division multiplex (DWDM) quality unmodulated wavelength  $\lambda_a$  from a source. The wavelength is modulated with a packet data at the access multiplexer 12e. The wavelength  $\lambda_a$  is multiplexed with other modulated wavelengths to form a sparse dense wavelength division multiplexed (S-DWDM) signal, the S-DWDM signal has an optical precision capable of being interleaved into the optical frequency constraints of a dense wavelength division multiplex (DWDM) wavelength plan used in a core network. The S-DWDM signal is transported to a metro photonic switch 14f, the metro photonic switch is all-optical, i.e. demultiplexer 62a optically demultiplexes the S-DWDM optical signal into its constituent wavelengths and the wavelength  $\lambda_a$  is switched by the optical switch 64a to the multiplexer 67a. The multiplexer 67a optically multiplexes the wavelength  $\lambda_a$  with other modulated wavelengths from the corresponding port of the other optical switches 64b-64h into a DWDM optical signal. The DWDM optical signal is transmitted to the core photonic switch 19a. See page 69, lines 10 -25 and Figure 14 of the present application.

A wavelength can be remotely delivered to the wavelength access point, and to configure the correct unmodulated optical carrier and deliver it to the end points for modulation. See page 41, lines 18-19 of the present application.

A control plane couples across to the Ethernet control, management planes as well as to the network controller 30. The photonic layer 23 is quasi-autonomous and configures its wavelength paths based on requests for end-to-end connectivity passed to the network controller 30. The controller/server then notifies each node 12, 14, 16, 19 of the required new end-to-end path and the nodes co-operate to establish such a path. See page 74, lines 11-18, and Figure 5 of the present application.

## (VI) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-26 are rejected under U.S.C. 103 (a) as being unpatentable over Hugenberg (U.S. Patent No. 6,714,545), hereinafter referred to as Hugenberg, in view of Hung (US Patent No. 6,583,901), hereinafter referred to as Hung.

## (VII) ARGUMENT

Appellants respectfully submit that claims 1-26 are inventive over Hugenberg and Hung.

The applied references fail to disclose or suggest the inventions defined by Appellants' claims, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention.

Hugenberg describes a VDSL based broadband data communication network for utilizing ATM/IP to an end user PC, thereby allowing a selectable bit rate delivery to the end users, with a Class of Service (COS) and Quality of Service (QOS) selection.

Compared to present claimed invention, Hugenberg at least does not teach or suggest the following features:

### Access Multiplexer

The Examiner asserts that Hugenberg teaches a plurality of access multiplexers in reference numeral 28 in Figure 2.

Hugenberg's reference numeral 28 in Figure 2 is a universal service access multiplexer (USAM). Hugenberg does not teach or suggest that the USAM multiplexes data packets from a plurality of end users onto a sparse dense wavelength division multiplexed (S-DWDM) wavelength as claimed in the

present invention.

The Examiner further asserts that Hugenberg at column 7, lines 38-41 teaches the limitation of “each access multiplexer operable to provide multiplexing of data packets from a plurality of end-users onto a sparse dense wavelength division multiplexed (S-DWDM) wavelength”.

Hugenberg at column 7, lines 38-41 reads: “A VDSL data network is provided that: [...] (2) supports two-way data services *over* high-speed fiber optics using SONET, Dense Wavelength Division Multiplexing, IP, ATM, and other transport systems”. Here, and throughout the disclosure, Hugenberg clearly discusses in general terms the two-way data services being carried *over* network layers in an OSI model, as should be apparent to a person skilled in the art.

Hugenberg therefore does not teach or suggest: a) multiplexing of data packets from a plurality of end-users onto a DWDM plan, or b) a photonic switch operable to switch the wavelengths into a DWDM signal for transmission.

#### Photonic Switch

The Examiner asserts that Hugenberg teaches a photonic switch in reference numeral 40 in Figure 2.

The term “photonic switch” is well defined in the art. A switch with optical input/output, and with an O-E-O switch core is called “optical switch”.

The photonic switch of the present invention operates in optical domain, without the cost burden of O-E-O conversion. “Referring to FIG. 8a there is graphically illustrated the communications layers corresponding to a path through the network of FIG. 8 from access to core node. As can be seen from the graph of FIG. 8a, other than the Ethernet access portion, *the entire*

*traverse from access to core is in the optical domain.* The transitions within the optical domain between  $\lambda$ , S-DWDM and DWDM are all effected using passive optical multiplexers and demultiplexers with amplification on a per wavelength or small group of wavelengths basis to offset losses.” See page 55, lines 24 to 30, and Figure 8 of the present application.

The photonic switch of the present invention includes a plurality of S-DWDM demultiplexers, and a plurality of S-DWDM multiplexers. The S-DWDM multiplexers and S-DWDM demultiplexers are each coupled between a respective S-DWDM I/O port and a portion of a layered photonic switching core comprised of switches. Each of the switches is connected to the S-DWDM multiplexers and S-DWDM demultiplexers such that each switch, switches optical signals of the same wavelength. It should be apparent to a person skilled in the art that this is a non-blocking switch architecture capable of switching any optical input port to any optical output port. See page 65, lines 18 to 32, and Figure 12 of the present application.

Hugenberg’s reference numeral 40 in Figure 2 is clearly a router and aggregation device, which is an electrical device. “In the aggregation device, each bit rate service is mapped to a range of virtual path identifiers/virtual channel identifiers (VPI/VCIs) (ATM layer) where each VPI/VCI range on the switch has a corresponding ATM contract for traffic shaping.” See column 4, line 48 to column 5, line 15 of Hugenberg.

A person skilled in the art would readily appreciate that in order to map each bit rate service to a range of VPI/VCI in an aggregation device, electric manipulation of data in the ATM cells is required. Therefore, the aggregation device 40 in Figure 2 of Hugenberg is clearly an O-E-O device and not a photonic switch as defined and claimed in the present application.



## S-DWDM

The Examiner asserts that Hung teaches S-DWDM by “providing a wavelength having an optical precision capable of being interleaved into the optical frequency constraints of a dense wavelength division multiplex wavelength plan used in the core network”.

S-DWDM are generated with an optical precision, especially with regards to optical carrier frequency, so they can map straight across into the tight optical frequency constraints of the DWDM network, although the carrier wavelengths are relatively coarsely spaced in the access plant. See page 21, lines 2 to 6 of the present application.

These S-DWDM wavelengths, having a carrier frequency spacing of an exact multiple of the DWDM wavelength plan used in the core network are carried over fiber cable to the photonic switches. See page 21, lines 6-8 of the present application.

In the present invention, the core node and access multiplexers are provided with multiple wavelength arrays of optical carrier sources, the outputs are grouped in groups matching the S-DWDM wavelength allocation, and generated with enough precision in a centralized multi-lambda generator to permit the concatenation of, or more accurately the *interleaving* of S-DWDM signals with the “exact multiple of the DWDM wavelength plan used in the core network” characteristics to flow directly into the DWDM core-network side ports on the edge photonic switch. See page 42, lines 12 to 18 of the present application.

Hung teaches dynamic channel allocation in an optical communications system. More particularly, Hung teaches multiplexing of wavelengths by reducing the spectral width of the optical signal from the DFB lasers (column 17, line 50 to column 18, line 10), Hung does not teach interleaving of wavelengths.

Multiplexing of wavelengths through a multiplexer is known in the art. Interleaving S-DWDM through a photonic switch, as described and claimed in the present invention is novel and inventive.

Not all wavelengths can be interleaved into a DWDM signal, even if they have the required optical precision, an example would be two lambdas with the same wavelength from two distinct sources, they cannot be interleaved into the same DWDM signal. It is the fact that the S-DWDM from all sources do not overlap, i.e. the S-DWDM from all sources have *spectral positions* of a multiple of the DWDM plan as described throughout the disclosure of the present claimed invention, allows the S-DWDM being interleaved.

Hung does not teach or suggest “S-DWDM wavelength having an optical precision capable of being interleaved into the optical frequency constraints of a dense wavelength division multiplex (DWDM) wavelength plan used in a core network” as claimed by the present invention. In fact, Hung does not use the term “interleave” or similar terms.

Furthermore, by stating “system control unit 1360 selects an idle channel to achieve maximum isolation with used channels, i.e., the channel is selected to have the *maximum separation* from channels in use” (column 9, lines 3 to 6), Hung actually teaches away from the claimed limitation “the S-DWDM wavelength having an optical precision capable of being interleaved into the optical frequency constraints of a dense wavelength division multiplex (DWDM) wavelength plan used in a core network” of the present application.

#### (VIII) CONCLUSION

Appellants have demonstrated that the present invention as claimed is clearly distinguishable over the art cited of record. Therefore, Appellants respectfully request the Board of Patent Appeals and Interferences to reverse the rejection of the Examiner, issued on February 22, 2007, and instruct the Examiner to issue a notice of allowance of all claims.

Respectfully Submitted,

/Xiang Lu/

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## CLAIMS APPENDIX

The Appealed Claims:

1. A communications network for a metropolitan area comprising:

a plurality of access multiplexers, each access multiplexer operable to provide multiplexing of data packets from a plurality of end-users onto a sparse dense wavelength division multiplexed (S-DWDM) wavelength; the S-DWDM wavelength having an optical precision capable of being interleaved into the optical frequency constraints of a dense wavelength division multiplex (DWDM) wavelength plan used in a core network;

a photonic switch, coupled to the access multiplexers via fiber optic cable for carrying a plurality of S-DWDM wavelengths, being all-optical and operable to switch the plurality of S-DWDM wavelengths into a DWDM signal for transmission; and

a core node being part of the core network, coupled to the photonic switch via a fiber optic cable for carrying the DWDM signal, and operable to route the data packets within the communications network or out to a long haul network.

2. The network as claimed in claim 1 wherein the photonic switch includes a multi-wavelength source for generating DWDM quality wavelengths for supplying the access multiplexers with unmodulated wavelengths upon which to multiplex data packets.

3. The network as claimed in claim 1 wherein the core node includes a photonic switch and a packet switch.

4. The network as claimed in claim 3 wherein the photonic switch includes a multi-wavelength source for generating DWDM quality wavelengths for supplying the packet switch with unmodulated wavelengths upon which to multiplex data packets.
5. The network of claim 1 wherein the data packets are Ethernet packets.
6. The network of claim 5 wherein a portion of the data packets are transmitted from a particular end-user to a particular access multiplexer over a local loop, connecting the particular end-user to the particular access multiplexer, using a digital subscriber line DSL protocol.
7. The network of claim 6 wherein the DSL protocol is a very-high-data-rate VDSL protocol.
8. The network of claim 1 wherein the photonic switches are capable of switching at the wavelength, group of wavelength, and fiber level.
9. The network of claim 1 wherein the core node is capable of switching at the wavelength, group of wavelength, and fiber level.
10. The network of claim 9 wherein the core node is capable of switching data packets based on a service to which the data packet pertains.
11. The network of claim 10 further comprising a plurality of photonic switches, each of the photonic switches connected to at least one other photonic switch and the core node.
12. The network of claim 11 further comprising a plurality of core nodes, each of core nodes connected to at least one other core node.

13. The network as claimed in claim 1 wherein the core node includes a wavelength converter for converting one wavelength to another wavelength to provide an end-to-end photonic connection across the network.

14. The network as claimed in claim 13 wherein the wavelength converter includes opto-electronic devices.

15. The network as claimed in claim 14 wherein the wavelength converter includes photonic devices.

16. A method of operating a metropolitan photonic network comprising the steps of:

providing to an access multiplexer a dense wavelength division multiplex (DWDM) quality unmodulated wavelength from a source remote therefrom;

modulating the wavelength with packet data at the access multiplexer;

multiplexing the wavelength together with other modulated wavelengths to form a sparse dense wavelength division multiplexed (S-DWDM) signal, the S-DWDM signal having an optical precision capable of being interleaved into the optical frequency constraints of a dense wavelength division multiplex (DWDM) wavelength plan used in a core network;

transporting the S-DWDM signal to a metro photonic switch, the metro photonic switch being all-optical;

demultiplexing the S-DWDM signal to a plurality of wavelengths;

switching each of the plurality of wavelengths on a per wavelength basis;

multiplexing different switched wavelengths to form a DWDM signal; and

launching the DWDM signal toward a core node in the core network.

17. The method as claimed in claim 16 wherein the step of providing to an access multiplexer a DWDM quality unmodulated wavelength includes generating a plurality of DWDM quality wavelengths adjacent to a metro photonic switch and coupling one of the plurality of wavelengths to a fiber from the metro photonic switch to the access multiplexer.
18. The method as claimed in claim 17 wherein the step of modulating the wavelength with packet data at the access multiplexer includes the step of receiving packet data from the access network and modulating the unmodulated wavelength from the metro photonic switch therewith.
19. The method as claimed in claim 18 wherein the step of multiplexing the wavelength together with other modulated wavelengths to form a sparse dense wavelength division multiplexed (S-DWDM) signal includes the step of selecting wavelengths having a predetermined separation.
20. The method as claimed on claim 19 wherein the DWDM signal includes  $N$  wavelengths and the predetermined separation is  $s$ , where  $N > s$  and  $N$  and  $s$  are integers.
21. The method as claimed in claim 20 wherein  $N$  is 40 and  $s$  is 5.
22. A photonic metropolitan network comprising:

means for providing to the access multiplexer a dense wavelength division multiplex (DWDM) quality unmodulated wavelength from a source remote therefrom;

an access multiplexer including means for modulating the wavelength with packet data at the access multiplexer, and means for multiplexing the wavelength together with other modulated wavelengths to form a sparse dense wavelength division multiplexed (S-DWDM) signal, the S-DWDM signal having an optical precision capable of being interleaved into the optical frequency constraints of a dense wavelength division multiplex (DWDM) wavelength plan used in a core network;

means for transporting the S-DWDM signal to a metro photonic switch;

wherein the metro photonic switch is all-optical, includes ~~including~~ means for demultiplexing the S-DWDM signal at the metro photonic switch to a plurality of wavelengths; means for switching each of the plurality of wavelengths on a per wavelength basis; means for multiplexing different switched wavelengths to form a DWDM signal; and means for transporting the DWDM signal to a core node in the core network.

23. A communications network for a metropolitan area comprising:

a plurality of access multiplexers, each access multiplexer operable to provide multiplexing of data packets from a plurality of end-users onto a sparse dense wavelength division multiplexed (S-DWDM) wavelength, the S-DWDM wavelength having an optical precision capable of being interleaved into the optical frequency constraints of a first separation being multiple of a second separation in a dense wavelength division multiplex (DWDM) wavelength plan used in a core network;



a photonic switch, coupled to the access multiplexers via fiber optic cable for carrying a plurality of the S-DWDM wavelengths, being all-optical and operable to switch the plurality of S-DWDM wavelengths into a DWDM signal for transmission;

a core node, coupled to the photonic switch via a fiber optic cable for carrying the DWDM signal, and operable to route the data packets within the communications network or out to a long haul network; and

a control plane coupled to the photonic switch and the core node for effecting end-to-end photonic connectivity.

24. The communications network as claimed in claim 23 wherein the core node includes a packet router and a photonic switch coupled together to effect packet level switching for packets originating at the access multiplexers.
25. The communications network as claimed in claim 24 wherein the core node includes a wavelength converter coupled to the photonic switch to effect an all photonic connection through the network.
26. The communications network as claimed in claim 23 wherein the photonic switch includes a first plurality of input ports and a second plurality of output ports, with the first being greater than the second, whereby the photonic switch effects concentration of the S-DWDM wavelengths from the access multiplexers.